

March 22, 1966

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3,241,507

APPARATUS FOR AND METHOD OF FORMING PATTERNS BY HIGH-LOOP
TUFTS AND LOW-CUT TUFTS IN A PILE FABRIC

Filed Dec. 5, 1960

6 Sheets-Sheet 1

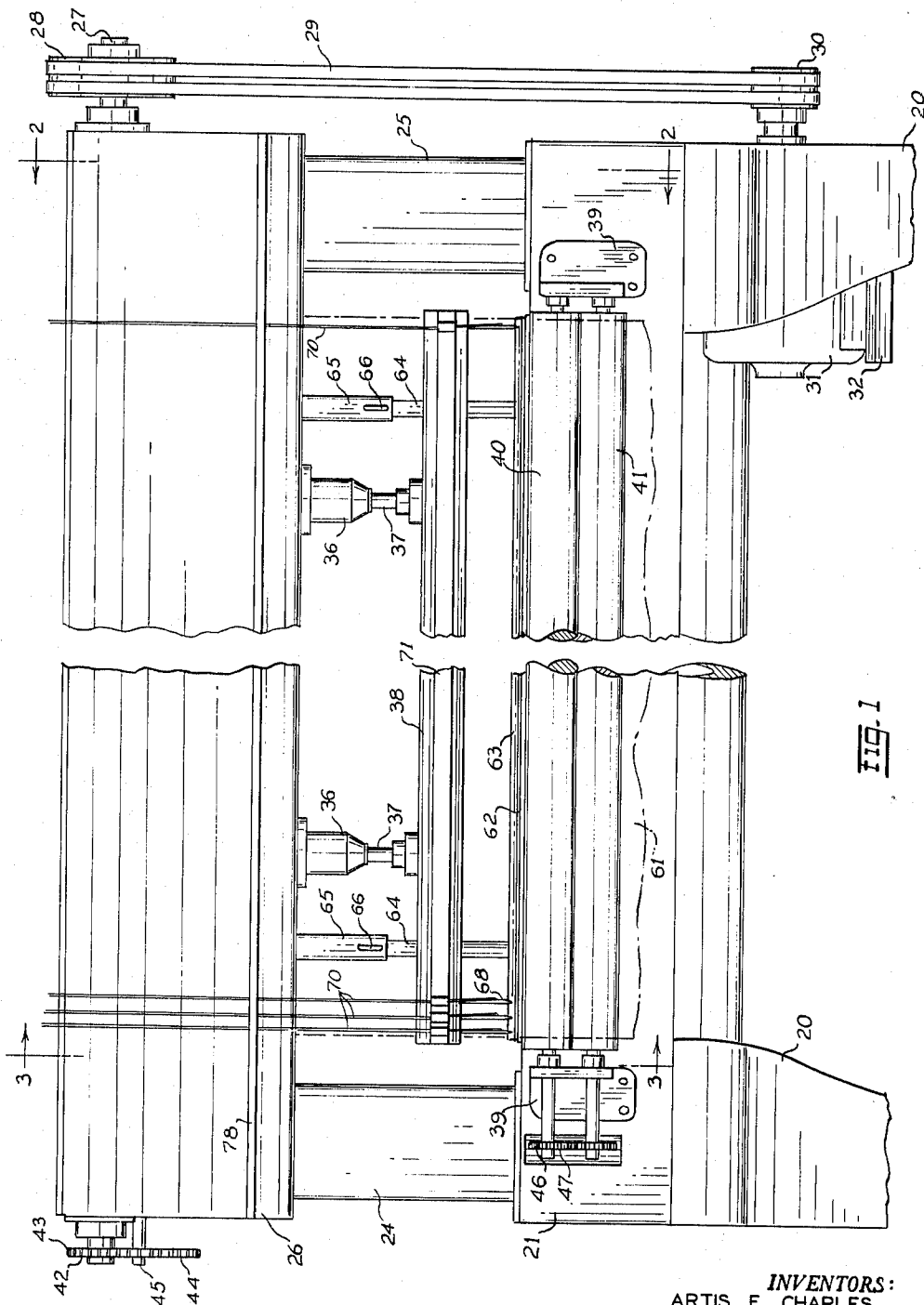


FIG. 1

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6 Sheets-Sheet 2

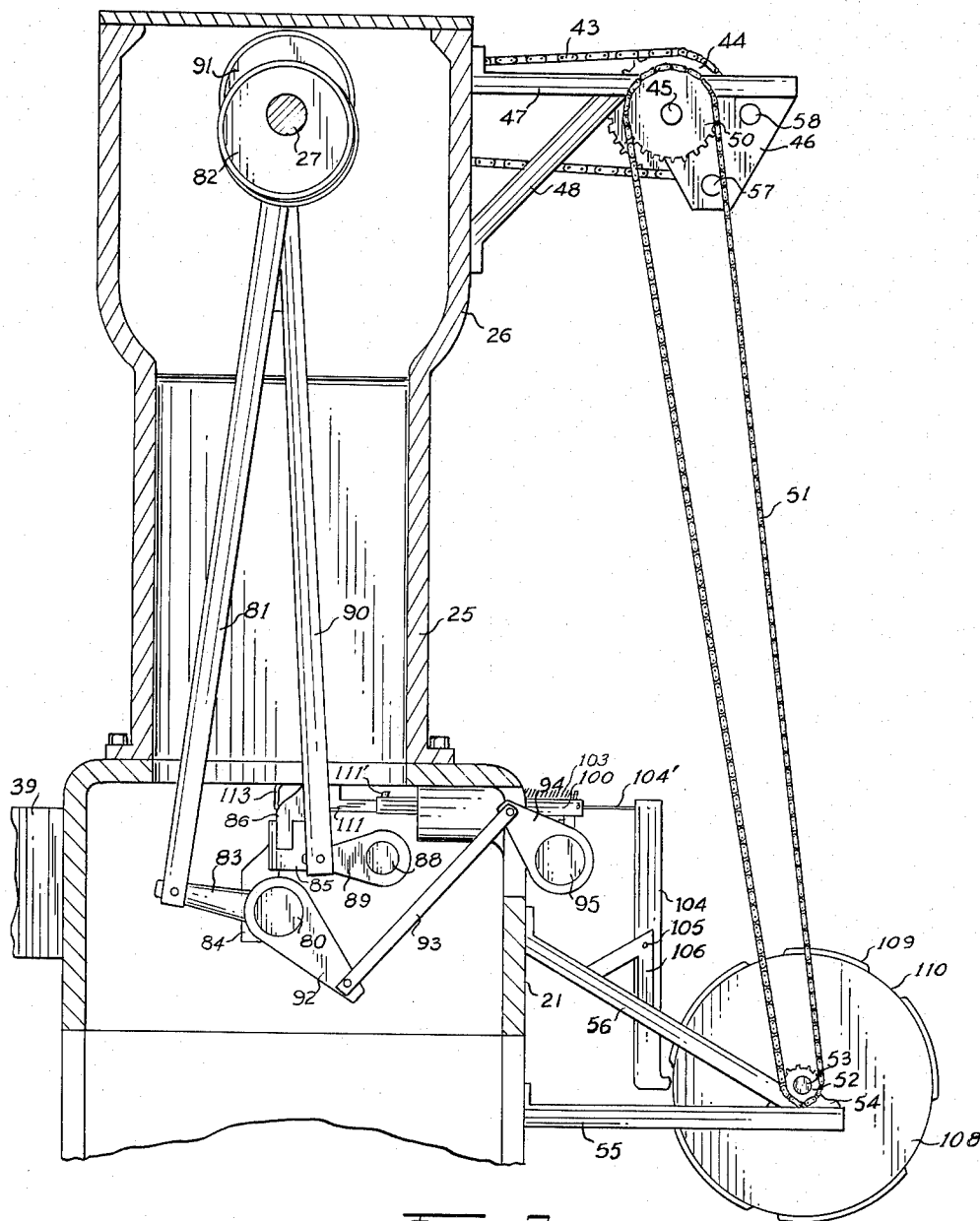


FIG. 2

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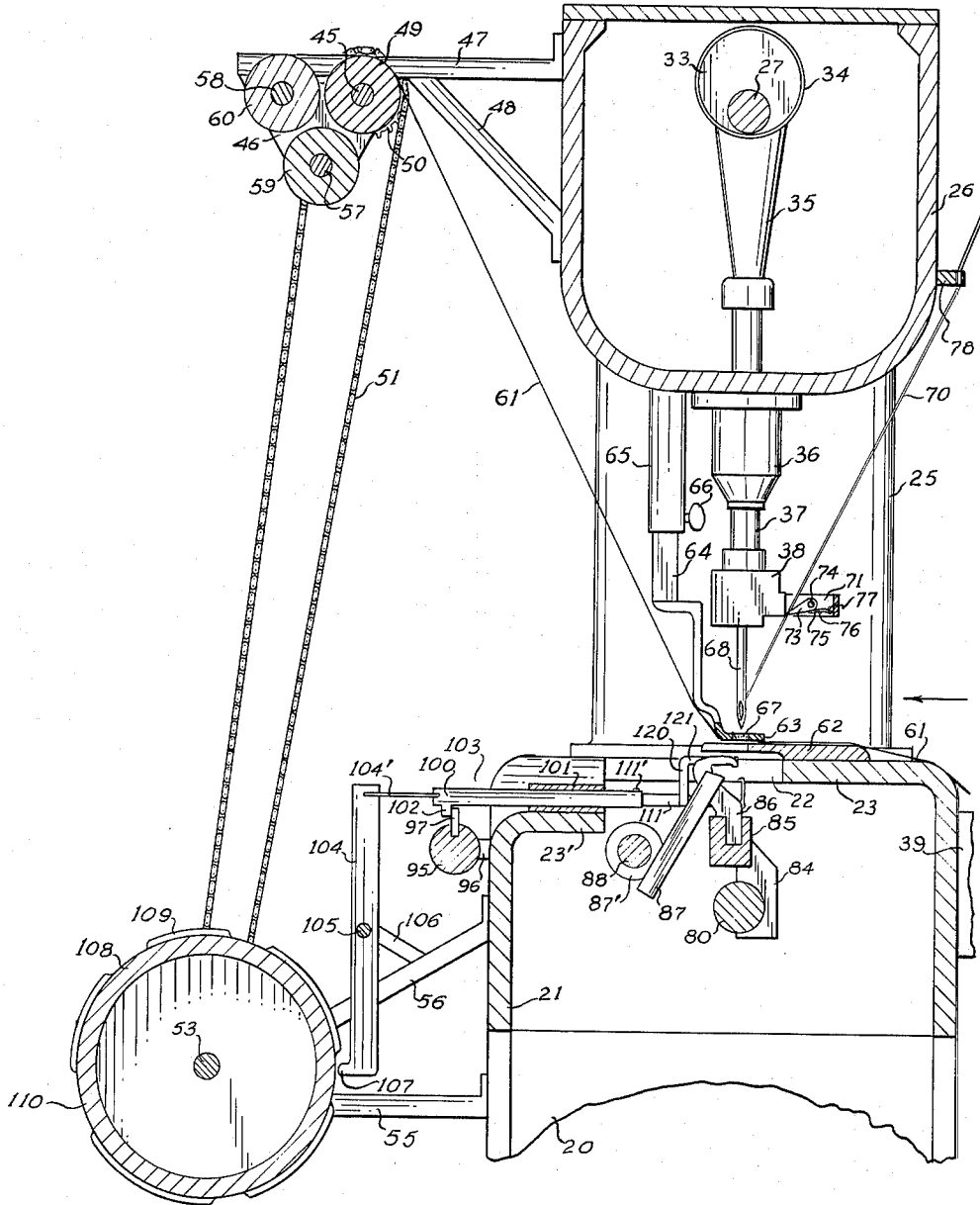


FIG. 3

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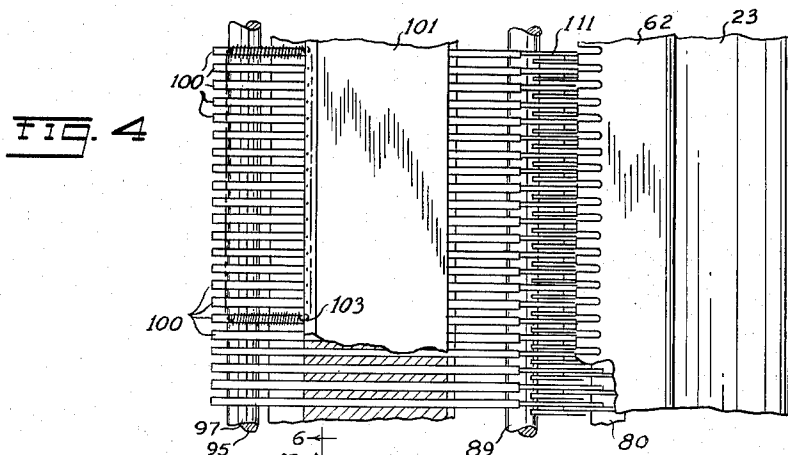
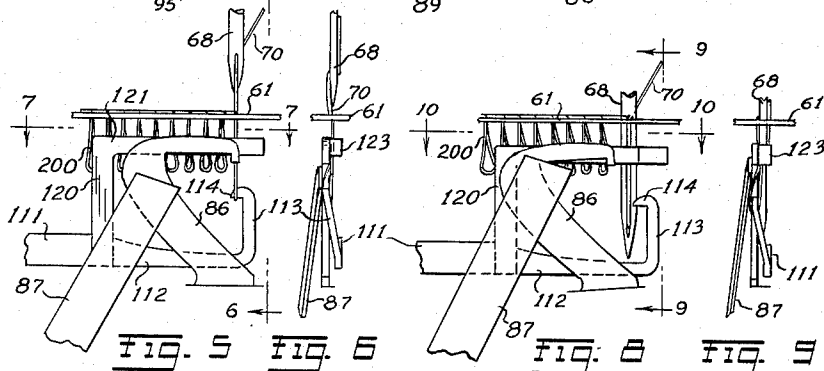
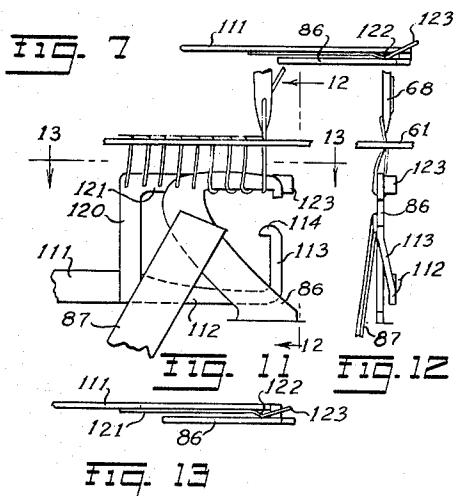
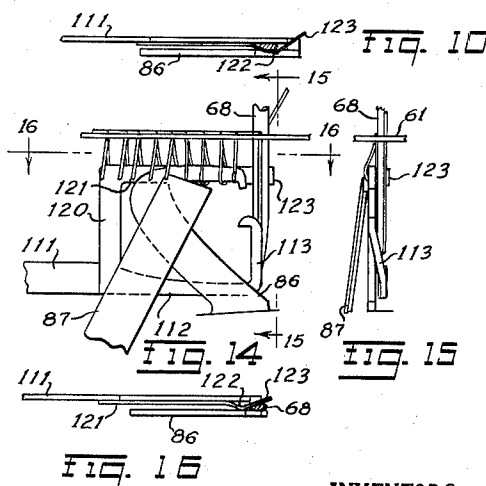
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6 Sheets-Sheet 5

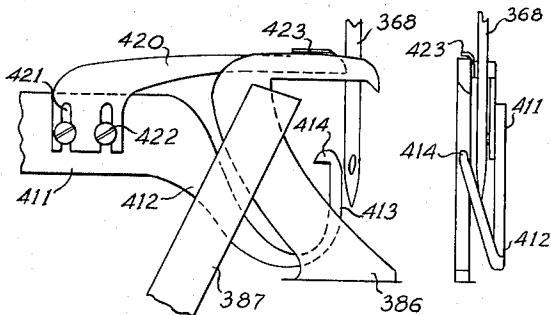


FIG. 17

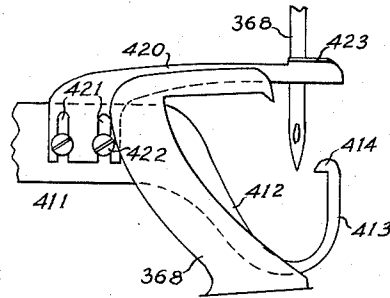


FIG. 18

FIG. 19

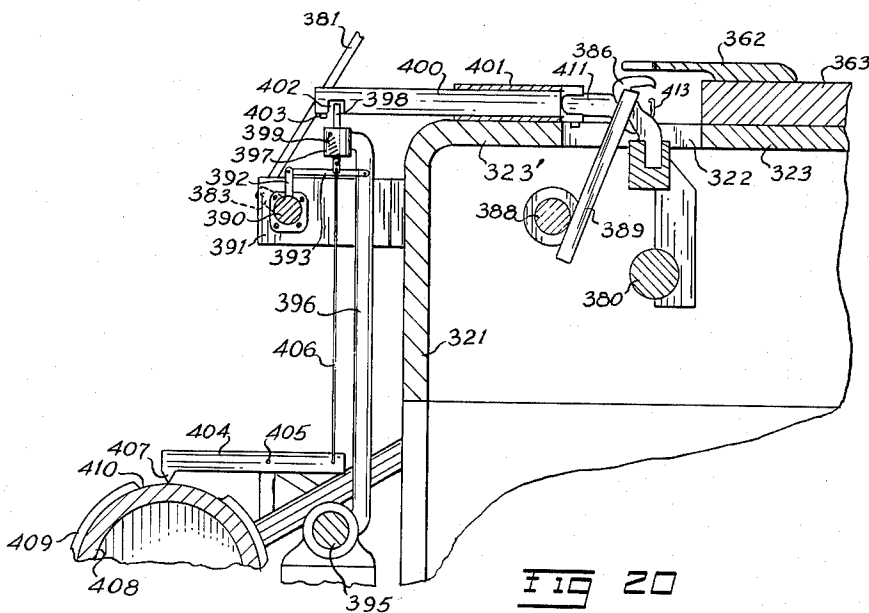


FIG. 20

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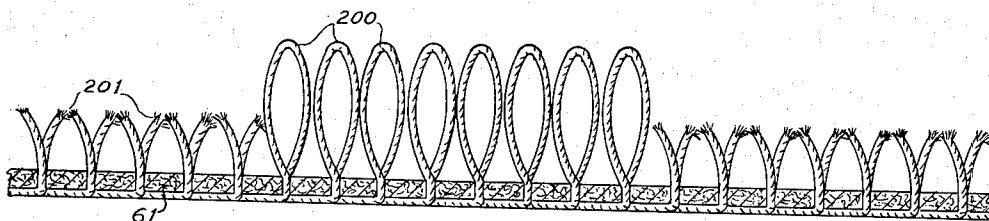


Fig. 22

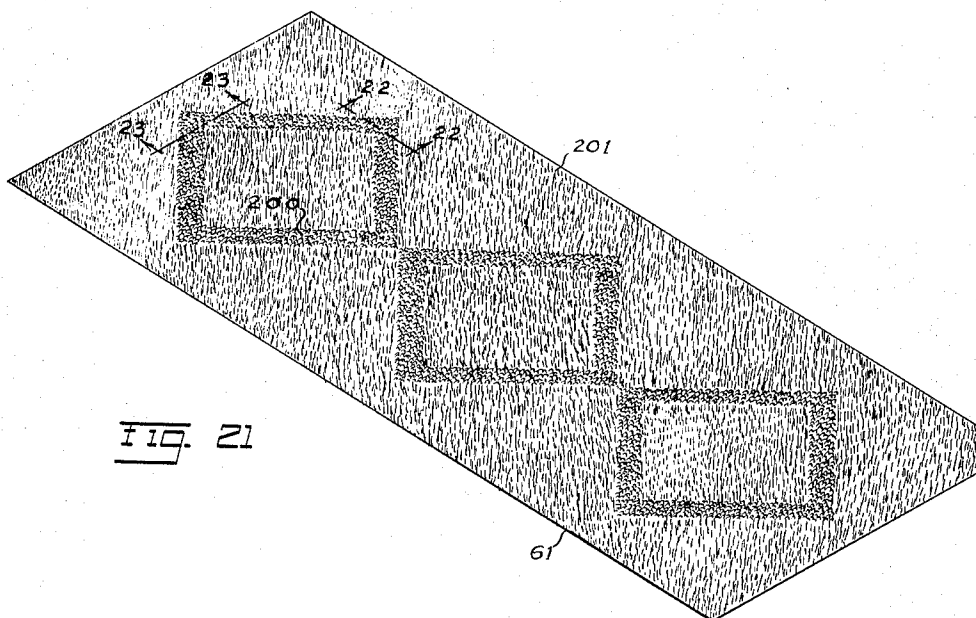


Fig. 21

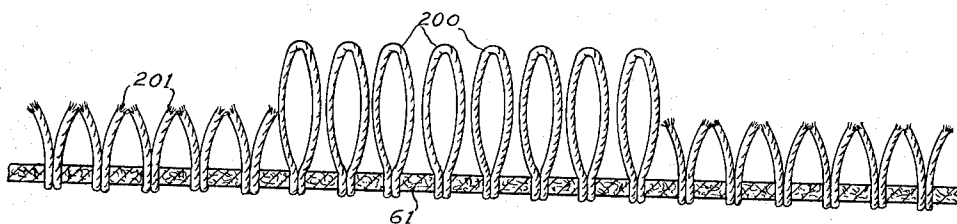


Fig. 23

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APPARATUS FOR AND METHOD OF FORMING PATTERNS BY HIGH-LOOP TUFTS AND LOW-CUT TUFTS IN A PILE FABRIC

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Filed Dec. 5, 1960, Ser. No. 73,926

7 Claims. (Cl. 112—79)

This invention relates to a multi-needle tufting machine and is more particularly concerned with an apparatus and method of forming patterns by high-loop tufts and low-cut tufts in a tufted pile fabric.

In the past many and various devices have been devised for producing designs in pile fabric. In the earlier days of the tufting industry a pattern was formed in the base fabric by overlaying or by using different needles to form different lengths of loops. The more modern developments, however, include the well known high-loop pile machines such as those developed by John H. Boyles and Joe H. Nix. The pattern attachments of these machines have taken various forms, such as variable speed rolls, arrest solenoids, and intermeshing slats, all of which vary the feed of the yarn to rob usually the preceding loops as the needles sew the next loops and can only produce high-low loop pile fabric. Other advances in the art include combination cut loop pile machines wherein the selected loops are transferred from the looper and those retained on the looper are cut.

Attempts have been made to vary the height of selected loopers and thereby obtain different pile heights; however, such machines to our knowledge have not proved too satisfactory.

Prior to the present invention, however, no multi-needle tufting machine has been produced wherein high loop tufts and low cut tufts are produced in a continuous fashion to provide a predetermined pattern in the goods. Such an arrangement in a tufting machine has heretofore been considered impracticable because the high loops would catch in the cut pile loopers.

Briefly, the present invention includes the customary multi-needle tufting machine frame and the horizontally disposed vertically reciprocable needle carrier with its transversely aligned needles cooperating with cut pile loopers. The novel part of the present invention includes an additional set of loopers within the cross bed of the multi-needle tufting machine frame. This additional set of loopers is loop pile loopers, the hooks of which are arranged below the hooks of the cut pile loopers. The loop pile loopers are selectively movable according to a predetermined pattern into and out of an operable position and each operates in conjunction with means, such as a deflector, for directing the yarn loops away from the cut pile looper. The individual positioning of the loop pile loopers is controlled preferably by a pattern control means operated in synchronization with the operation of the multi-needle tufting machine.

By such an arrangement, the long loops retained on the loop pile loopers are directed by the deflectors around the cut pile loopers and are not engaged thereby while those loops of yarn which are not engaged by the loop pile loopers are engaged by the cut pile loopers and hence are cut, forming the low cut pile. With each needle is a thread feeding arrangement which travels with the needle bar so that the loops are drawn tight against the associated loopers, regardless of whether the loop is engaged by the loop pile looper or by the cut pile looper.

Accordingly, it is an object of the present invention to provide a multi-needle tufting machine capable of, and a method of, sewing in a base fabric a plurality of tufts, certain of the tufts being formed of high loops of yarn

2

and certain other of the tufts being formed of low cut yarn according to a prescribed pattern.

Another object of the present invention is to provide a machine and process capable of producing in a continuous fashion high-loop pile, low-cut pile fabric.

Another object of the present invention is to provide a multi-needle tufting machine in which certain loopers are individually controllable to select the loops which are to be formed thereby.

Another object of the present invention is to provide a multi-needle tufting machine which employs many standard parts and to which existing machines may be modified without great expense.

Another object of the present invention is to provide a new and novel looper assembly for multi-needle cut pile tufting machines.

Another object of the present invention is to provide a new and novel high-loop, low-cut pile fabric.

Other objects, advantages and features of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings wherein like characters of reference designate corresponding parts throughout the several views, and wherein:

FIG. 1 is a front elevational view, partially broken away, of a multi-needle tufting machine constructed in accordance with the present invention, the machine being adapted to produce high-loop, low-cut pile fabric.

FIG. 2 is an enlarged cross sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is an enlarged cross sectional view taken along line 3—3 of FIG. 1.

FIG. 4 is an enlarged fragmentary plan view, partially broken away and illustrating the mechanism controlling the loop pile loopers and the yarn deflector.

FIG. 5 is an enlarged schematic side elevational view of one of the looper mechanisms of the present invention, the mechanism being shown as sewing consecutive loops of yarn and the needle being shown in the top dead center position.

FIG. 6 is a cross sectional view taken along line 6—6 in FIG. 5.

FIG. 7 is a cross sectional view taken along line 7—7 in FIG. 5.

FIG. 8 is a side elevational view similar to FIG. 5 and showing the needle in the bottom dead center position of the machine.

FIG. 9 is a cross sectional view taken along line 9—9 in FIG. 8.

FIG. 10 is a cross sectional view taken along line 10—10 in FIG. 8.

FIG. 11 is a side elevational view similar to FIGS. 5 and 7 but showing the looper mechanism forming cut tufts, the needle therein being in the top dead center position.

FIG. 12 is a cross sectional view taken along line 12—12 in FIG. 11.

FIG. 13 is a cross sectional view taken along line 13—13 in FIG. 11.

FIG. 14 is a side elevational view similar to FIG. 11 and showing the needle therein at the bottom dead center position.

FIG. 15 is a cross sectional view taken along line 15—15 in FIG. 14.

FIG. 16 is a cross sectional view taken along line 16—16 in FIG. 14.

FIG. 17 is a fragmentary side elevational view of a detail showing a modified form of loop pile looper and deflector constructed in accordance with the present invention and operating in conjunction with the cut pile looper and its associated needle, the needle being shown immediately after bottom dead center and on its up stroke,

the loop pile looper being withdrawn such that a cut pile loop would be formed.

FIG. 18 is an end view of the mechanism shown in FIG. 17.

FIG. 19 is a view similar to FIG. 17 but with the loop pile looper being operative, the needle being shown on its down stroke.

FIG. 20 is a fragmentary vertical sectional view of a portion of a conventional tufting machine having the modified attachment for producing high-loop pile and low-cut pile affixed thereto according to the present invention.

FIG. 21 is a perspective view of a piece of fabric produced according to the present invention on the mechanism shown in FIG. 1.

FIG. 22 is a cross sectional view taken along line 22—22 of the fabric in FIG. 21.

FIG. 23 is a cross sectional view taken along line 23—23 in FIG. 21.

Referring now in detail to the embodiments chosen for the purpose of illustrating the present invention and particularly to FIGS. 1, 2 and 3, it being understood, however, that the drawings depict but a few embodiments of the present invention and it is not intended that the invention, in its broader aspects, be limited to the exact details herein depicted, numeral 20 denotes the legs of a multi-needle tufting machine. Legs 20 support a transverse cross bed 21 which is hollow, having a transverse opening 22 between the inwardly turned opposed upper flanges 23, 23'. At the opposite ends of the cross bed 21 are upstanding stanchions or end frames 24 and 25 which support a cross head member 26 within which extends the horizontal overhead main drive shaft 27 appropriately supported by bearings. The shaft 27 extends outwardly at the end of the cross head member 26 and is provided with a pulley 28 around which are continuous V-belts 29. The V-belts 29 are, in turn, driven by a pulley 30 connected to the shaft of a motor 31. The motor 31 is supported on a bracket 32 extending from one of legs 20.

Along the shaft 27 there are provided a plurality of eccentrically mounted circular cams, such as cam 33, in FIG. 3. Each cam 33 is concentric with respect to the other similar cams and receives a connecting rod bearing, such as bearing 34, from which extends the connecting rod 35. The cross head member 26 is provided with a plurality of spaced, downwardly extending journal members 36 which receive for slidable movement needle bar supporting rods 37. The upper ends of supporting rods 37 are pivoted to the lower ends of connecting rods 35 while the lower ends of the supporting rods 37 support a transverse needle bar 38 above the upper opening 22.

Upon rotation of the motor 31, the belts 29 rotate through pulley 28, the drive shaft 27 and thereby reciprocate through cams 33, the connecting rods 35. The reciprocation of the connecting rods 35 will reciprocate the supporting rods 37 which reciprocate in a vertical path the needle bar 38.

Mounted on the front side of the cross bed 21 and being supported by appropriate brackets 39 are the two infeed rollers 40 and 41. The rollers 40 and 41 are driven by means of a chain and sprocket, such as chain 46 and sprocket 47, the chain 46 being driven by a suitable sprocket which is driven in the customary way from the main drive shaft 27.

The mechanism heretofore described is essentially conventional in most multi-needle tufting machines except for the purpose of receiving the attachment hereinafter described, the inwardly directed flanges 23, 23' of the cross bed 21 are arranged at slightly different levels, flange 23' being arranged below flange 23 in the embodiment of FIGS 1 through 16.

According to the present invention, the end of shaft 27 opposite pulley 28 projects from the end of the tufting machine and is provided, as seen in FIG. 1, with a sprocket 42 which receives a continuous chain 43 extend-

ing therearound and extending around a sprocket 44. The sprocket 44 shown in FIGS. 1 and 2 is connected to a shaft 45 journaled by depending brackets 46 carried by struts 47 extending rearwardly from the cross head member 26. Reinforcing struts 48 provide additional support for the struts 47. Between the brackets 46, the shaft 45 is provided with an outfeed roller 49 and outwardly thereof with a sprocket 50. Around the sprocket 50 is a continuous chain 51 which extends in a generally downward direction to drive a sprocket 52 on shaft 53. The shaft 53 is supported for rotation between pillow blocks 54 which are, in turn, supported by rearwardly extending braces 55 mounted on the rear side of the cross bed 21. Struts 56, which extend from cross bed 21 rearwardly and downwardly, provide additional support for the braces 55.

Between the brackets 46, intermeshing gears (not shown) driven by shaft 45 drive shafts 57 and 58 which are respectively provided with the outfeed rolls 59 and 60, the shafts 57 and 58 being journaled appropriately between the brackets 46.

Referring now to FIG. 3, it will be understood that the usual base fabric 61 is fed to the infeed rolls 40 and 41, seen in FIG. 1, and thence over the usual base plate 62 on flange 23 and beneath the needle bar 38. Between the base plate 62 and the needle bar 38 is a fabric hold-down foot 63 carried by a plurality of support rods 64 which are slidably received within sleeves 65 depending from the cross head member 26. Set screws 66 in the sleeves 65 retain the rods 64 in place and yet permit vertical adjustment of the foot 63 when desired. It will be understood that the foot 63 is provided with a plurality of holes 67 through which the needles 68 travel when being reciprocated by the needle bar 38. The function of foot 63 is to hold down the fabric 61 as the fabric passes across the base plate 62.

After the fabric 61 has passed beneath the foot 63 it extends in the present embodiment upwardly and rearwardly over the roll 49, and thence around the rolls 59 and 60. The outfeed rolls 49, 59, and 60 are operated at a slightly higher peripheral speed than the speed of the infeed rollers 40 and 41 and hence the fabric 61 is retained in tension as it passes across the base plate 62 and across the opening 22.

As best seen in FIGS. 1 and 3, the needles 68 are arranged transversely of the travel of the fabric 61, the needles being in alignment so as to be simultaneously inserted with yarns 70 through the fabric 61 and simultaneously withdrawn from the fabric 61 upon each reciprocation of the needle bar 38. Each needle 68 penetrates the fabric to a predetermined depth to insert its loop of yarn 70 in the base fabric. Thus, the tufts formed are longitudinally and transversely aligned as seen in FIGS. 22 and 23.

It will be understood by those skilled in the art that a thread jerker or feed mechanism should be included with the machine of the present invention. While there are many types of thread jerkers or yarn feed mechanisms in existence heretofore, we prefer to employ a mechanism which is carried by the needle bar 38. This yarn feed mechanism includes as best seen in FIG. 3 a frame 71 having a plurality of slots within which are a plurality of fingers, such as finger 73, journaled on a common pivot rod 74. The frame 71 of the feed mechanism is secured to the needle bar 38 whereby the fingers extend inwardly and downwardly to engage the side of the needle bar 38, each finger 73 being urged into engagement by a spring 75 acting along the lower edge of the finger 73 and retained in place by a pair of parallel bars 76 and 77. Above the feed mechanism is a guide bar 78 carried by the cross head member 26 and having a plurality of holes aligned with the needles 68 and the fingers such as finger 73. Each yarn 70 is fed from the creel (not shown) through a hole in guide bar 78 and between the finger 73 and the side of the needle bar 38 to the eye

of its needle 68. The yarns, such as yarn 70, are therefore parallel to each other.

When the needle bar 38 is reciprocated and the looper mechanism below fabric 61 engages the yarn 70, the upward movement of the needle bar will permit the yarn 70 to be fed through the yarn feed mechanism against only a slight tension applied by finger 73; however, if the tension between the creel (not shown) and the yarn feed mechanism tends to pull the yarn in the opposite direction, the finger 73 tends to bind against the side of the needle bar 38 to prevent the yarn 70 from being withdrawn.

Looper mechanism

Below the base plate 62 and within the cross bed 21 is the novel looper mechanism. This looper mechanism includes the conventional cut pile loopers with their associated knives. In more detail, the cut pile looper mechanism includes a cut pile looper shaft 80, shown in FIGS. 2 and 3, which is rocked back and forth by a pitman 81 driven from a cam 82 mounted on shaft 27. The pitman 81 is connected to a lever 83 extending radially from the cut pile looper shaft 80.

The shaft 80 is provided with a plurality of upstanding ribs such as rib 84 seen in FIG. 3. The ribs 84 carry a transverse looper carrying block 85 in which are disposed in spaced parallel relationship a plurality of axially aligned cut pile loopers 86, corresponding to the number of needles 68 and arranged adjacent the path of travel of needles 68, respectively. The loopers 86, as is customary, face the travel of the base fabric 61 across the machine and each looper 86 is arranged below its associated needle 68 so as to pass adjacent to the needle when the needle begins its up stroke, the cam 82 and lever 83 being so arranged that the loopers 86 are simultaneously rocked in a clockwise direction into engagement with yarns 70 as the needles 68 begin their upstroke and are rocked in a counterclockwise direction as the needles begin their down stroke. Cooperating with each looper 86 is a knife 87 which is mounted on a collar 87' carried on the knife shaft 88. The knife shaft 88 is rocked back and forth in synchronization with the rocking of the cut pile looper shaft 80. The mechanism for accomplishing this includes, as seen in FIG. 2, a rocker arm 89 which extends radially from the knife shaft 88, and a pitman 90 which is pivotally connected to the rocker arm 89 and is actuated by a circular cam 91 carried eccentrically by the main drive shaft 27.

Extending radially from the cut pile looper shaft 80 is a lever 92 which connects through a link 93 to a lever 94 on the loop pile looper actuator shaft 95. Actuator shaft 95 is supported by brackets 96 extending rearwardly from the cross bed 21. The function of shaft 95 is to rock backward and forward in timed relationship with the stroke of needle 68, as well be understood hereinafter. The shaft 95 is provided with a longitudinally extending keyway which receives an upstanding key 97 seen in FIGS. 3 and 4.

Above the key 97 are a plurality of spaced parallel, essentially horizontal, actuator arms or bars 100, best seen in FIGS. 3. Bars 100 project inwardly toward the opening 22, being received slidably in slots formed in a guide plate 101. The guide plate 101 is secured along the surface of flange 23' so as to retain the actuator bars 100 in their parallel position and yet permit inward and outward sliding of each actuator bar 100. At the outer end portion of each actuator bar 100, there is provided a downwardly extending key engaging finger 102 which is arranged to outwardly abut the key 97. For urging the actuator bars 100 into engagement with the key 97, there is provided a plurality of springs 103 carried by the guide plate 101 and connected to the respective actuator bars 100. Thus it is seen that upon rocking movement of the shaft 95, the key 97 will move all the actuator bars 100 outwardly and the springs 103 will urge the actuator

bars 100 inwardly when the shaft 95 rocks in a clockwise direction as seen in FIG. 3.

To selectively prevent the inward travel of the actuator arms according to a prescribed pattern, there are provided a plurality of levers such as lever 104, which are pivotally carried by a common shaft 105 supported between brackets 106 on struts 56. The upper end of each lever 104 terminates in about the plane of the actuator bars 100 and each lever is provided with a cable 104' connecting its upper end to the outer end of an aligned actuator bar 100. The lower end of each lever 104 is provided with an outwardly extending sensing finger 107 which rides along the periphery of a pattern drum 108 carried and rotated by shaft 53. It will be observed in FIG. 3 that the drum 108 has raised portions 109 and valley portions 110 which define a pattern to be sewn by the machine. It will be understood that the fingers, such as finger 107, are in alignment axially of the drum 108 in spaced relationship to each other throughout the length of the drum 108.

When the sensing finger 107 of any lever 104 is riding on a raised portion 109 of drum 108, its lever 104 will be rocked in a counterclockwise direction as viewed in FIG. 3 and will withdraw its associated actuator bar 100 so that the finger 102 of that arm no longer engages the key 97. On the other hand, when the finger 107 is riding on the valley portion 110 of the periphery of the drum 108, the cable 104' is sufficiently slack that the inward and outward movement of its associated actuator bar 100 is not impaired.

Telescopically received within the inner end of each actuator bar 100 is a loop pile looper carrying arm 111, the position of which may be adjusted longitudinally of arm 100 and secured in its adjusted position by a set screw 111' projecting through the actuator bar 100. Each looper carrying arm 111, as best seen in FIGS. 5, 8, 11 and 14, terminates in a tapered portion 112 having an upstanding slightly bent loop pile looper 113 with a hook 114 directed toward the actuator bar 100 so as to be arranged in a direction facing opposite to the direction of travel of the base fabric 61. It will be seen in FIGS. 3, 5, 8, 11 and 14 that the loop pile looper 113 has its hook or bill 114 below the horizontal plane of the hook or bill of the cut pile looper 86 and in FIGS. 6, 9, 12 and 15 that the loop pile looper 113 is offset slightly so as to have its hook 114 vertically aligned with the hook of looper 86 and immediately adjacent the path of travel of needle 68.

Mounted at an intermediate position on the loop pile looper carrying arm 111 is a selector supporting arm 120 on the end of which is mounted a horizontally extending selector finger 121 which extends over and beyond the hook 114 of loop pile looper 113. The selector finger 121 is preferably formed of spring steel so that it may be deflected by the needle 68 as will be explained hereinafter. As best seen in FIGS. 7, 10, 13 and 16, the loop pile looper carrying arm is about aligned with needle 68 and passes adjacent the side of looper 86 opposite the side against which knife 87 rides. The selector finger 121 is bent at numeral 122 toward the hook of the cut pile looper 86, being arranged in substantially the same plane therewith to ride against the side of the hook of looper 86. The extreme end portion 123 of the selector finger 121 is bent outwardly from the loop pile looper 86 beyond the inward bend 122 thereof.

As best seen in FIGS. 5-16, each looper mechanism includes the cut pile looper 86 with a knife 87 arranged to ride along one side of the cut pile looper 86. The selector finger 121 and the tapered portion 112 are arranged on the opposite side of the cut pile looper 86, the tapered portion 112 extending across the shank portion of the cut pile looper while the selector finger 121 extends in the horizontal plane defining the arc of travel of the hook of the loop pile looper 86.

It will be understood by those skilled in the art that,

for each needle 68, there is a looper assembly which comprises the loop pile looper 113, the cut pile looper 86 and selector finger 121. It will be observed in FIGS. 6, 9, 12 and 15 that the shank of loop pile looper 113 is bent from its vertical position so that the hook 114 is aligned vertically below and spaced from the hook of the cut pile looper 86. Thus, each looper when operating will pass between the needle 68 and the yarn 70 carried by the needle.

Modified looper mechanism

Referring now to FIGS. 17 through 20, the modified looper arrangement includes the conventional tufting machine having, as shown in FIG. 20, a cross bed 321 with its opposed flanges 323, 323' defining a central opening 322. This tufting machine also includes a bed plate 362 which is shimmed to a relatively high position by shim 363. Otherwise, the tufting machine is essentially the same as the previously described tufting machine of FIGS. 1, 2 and 3, having a pattern drum 408 with raised portions 409 and valley portions 410 along its periphery according to a prescribed pattern and driven in synchronization with the pattern main drive shaft of the machine.

The modified machine of FIG. 20 also includes the cut pile looper shaft 380 and the knife shaft 388 which respectively carry the cut pile loopers, such as looper 386, and knives, such as knife 387. The guide plate 401 is mounted on flange 323', being provided with slots through which the actuator bars, such as bar 400, project. As in the previous embodiment, the actuator bars 400 are selectively slidable inwardly and outwardly.

At the outer end portion of each actuator bar 400 is a downwardly opening slot 402, and outwardly beyond the slot 402 is a downwardly projecting finger 403. An idler shaft 395 arranged between the drum 408 and the cross bed 321 journals the lower ends of a plurality of upstanding rocker arms, such as arm 396. The upper ends of the rocker arms 396 are provided with a transversely extending pin carrying block 397 having a plurality of transversely aligned vertically disposed bores, each of which slidably receives an actuator pin 398 urged upwardly into an associated slot 402 by a spring 399. It will be understood that for each actuator bar 400 there is a pin 398 normally projecting into its slot 402.

The lower end of each pin 398 is connected to a downwardly extending cable 406 which is connected to one end of a horizontally extending lever 404 pivotally carried by a shaft 405 and having a sensing finger 407 at its other end riding along the periphery of drum 408. When the finger 407 is riding in the valley portion 410, substantially no force is exerted on the pin 398 and hence its spring 399 urges it upwardly into slot 402. When, however, the finger 407 is riding on the raised portion 409 of the periphery of drum 408, the lever 404 is tilted clockwise and cable 406 therefore urges the pin 398 out of slot 402.

It will be observed that the rocker arm 396 is relatively long and its arc of travel confined; therefore, the path of travel of the pins, such as pin 398, is essentially linear. It will also be observed that the cable 406 and rocker arm 396 are essentially parallel, the cable 406 lying in a radial path from shaft 395 with the connection between the lever 404 and cable 406 being close to shaft 395. Under such conditions, limited movement of rocker arm 396 does not appreciably effect the action of cable 406.

As a means for reciprocating all of the pins, such as pin 398, and thereby selectively reciprocate those actuator bars, such as bar 400, which the pins engage, we have provided a rock shaft 390 journaled by brackets 391 extending rearwardly from the cross bed 321. The rock shaft 390 is about parallel to shaft 395 and is mounted adjacent the block 397. Upstanding levers, such as lever 392, project radially from the shaft 390 to connect pivotally with the ends of links, such as link 393, which,

in turn, are connected to the upper end portions of the levers, such as lever 396. The shaft 390 is rocked back and forth in synchronization with the main drive shaft by a pitman 381 connected thereto and connected to a crank arm 383 extending from shaft 390.

By such an arrangement, the pins 398 are rocked back and forth and if a pin 398 is withdrawn from a slot 402, the pin passes below the actuator bar 400 on its forward stroke so that the actuator bar 400 is not urged forwardly. On its back stroke, the retracted pin 398 will, however, strike the finger 403 and hence assure that the actuator bar 400 is not urged forwardly.

At the other end of the actuator bar 400 is the telescopically mounted looper supporting arm 411 with its downwardly and forwardly extending shank 412 and an upwardly extending loop pile looper 413 having an inwardly directed hook or bill 414. As in the previous embodiment, the shank or tapered portion 412 passing adjacent the looper 386 but on the opposite side from the knife 387.

The selector 420 is a straight, thin, flexible metal member having parallel slots 421 through which bolts 422 pass into the side of the looper supporting arm 411, the slots 421 permitting limited adjustment of the selector. The selector 420 extends forwardly over the looper 413 and adjacent the arc of travel of the bill of looper 386 to extend between the bill of looper 386 and the needle 368. A curved shield 423 extends from the upper edge of selector 420 over the upper edge of the bill of looper 386 to deflect the yarn from the bill of looper 386 when the loop pile looper 414 is operative.

Operation

From the foregoing description, the operation of the present device will become apparent. The machine first is threaded in the usual manner so that yarns 70 pass through each of the needles 68, passing first through the yarn feed mechanism. With all of the needles threaded, the base fabric 61 is fed between the infeed rolls 40 and 41 and across the face plate 61, beneath the foot 63 and around the rolls 49, 59 and 58. The drum 108 is arranged with a prescribed pattern to be produced on the base fabric 61. Thereafter, motor 31 is started to rotate the main drive shaft 27. This, simultaneously, causes vertical reciprocation of the needles 68 as described above while rotating the infeed rolls 40 and 41 and the outfeed rolls 49, 58 and 59. Also, the drum 108 is rotated by the motor 31 in synchronization with the previously mentioned elements. With the rotation of the main shaft 27, all of the cut pile loopers, such as looper 86, are rocked inwardly and outwardly adjacent each of needles 68. As the cut pile loopers, such as looper 86, move away from the path of the needles, the knives, such as knife 87, move upwardly in an arcuate path and cut such loops as are collected on the various loop pile loopers, such as looper 86. The infeed and outfeed rolls 40, 41, 49, 58 and 59, of course, move the base fabric 61 gradually in the direction of the arrow in FIG. 3. Thus, the loops of yarn collected on loop pile looper 86 will be successively cut as illustrated in FIGS. 11, 12 and 13, provided the sensing finger 107 is riding on the high portion 109 of the periphery and will cause the lever 104 to pull the loop pile looper 113 out of a position for engagement with the yarn 70 carried by the needle such as illustrated in FIGS. 11-16.

On the other hand, if the finger 107 is riding along the valley 110 of the periphery of roll 108, there is no pull exerted by cable 104' on the actuator arm 100 and hence the actuator arm 100 will be controlled entirely by the operation of the shaft 95 and the spring 103, the spring 103 always urging the actuator arm 100 into a position such that the finger 102 rides against the key 97. Under such conditions, as the needle begins its down stroke, as illustrated in FIGS. 5, 6 and 7, the shaft 95 is so timed that it will rock in a counterclockwise direction as the

needle 68 moves downwardly so that the bend at numeral 122 of the selector finger 121 will be arranged in the downward path of the needle 68 and hence the needle will pass on the far side of the selector finger as illustrated in FIGS. 5-10. It will be understood that the needle 68 inserts the yarn upon each stroke of the needle 68 to a position below the hook 114 of the loop pile looper 113 and hence with the needle passing on the far side of the selector finger 121, the loop pile looper hook 114 will engage and hold the yarn 70 since it will be moved into such engagement by the rearward rocking of the shaft 95. Such an arrangement is illustrated in FIGS. 8, 9 and 10. On the upstroke of the needle, the looper hook 114 will retain the yarn and hence the yarn will be fed through the feed mechanism and pulled through the eye of the needle 68 as the needle is withdrawn. As the needle 68 approaches its top dead center position, the shaft 95 rocks forwardly and hence the spring 103 urges the actuator shaft forwardly so as to move the loop pile looper 113 forwardly and away from the loop, as the fabric 61 is moved rearwardly. Thus, upon each cycle, successive loops 200 are formed in the base fabric. Since the selector finger is at all times arranged to extend beyond the hook 114 of the loop pile looper, all loops 200 will be directed around the cut pile looper 86 by the selector finger 121.

It will be remembered that upon each cycle for forming loop pile loops 200, the cut pile looper 86 also moves into a position for engagement with the yarn 70; however, the finger 121 blocks the yarn 70 on the needle 68 from being engaged by the needle 68 as illustrated best in FIG. 10.

It will now be seen that by the rotation of the pattern drum 108, particular fingers 107 will be riding along the high area 109 for a given period of time and then along the valley area 110 for a given period of time. With the finger 107 riding along the valley area 110, the cut pile tufts such as illustrated in FIGS. 11, 14 and 17 will be formed; and with the finger 107 riding along the high area 109 the loop pile tufts, such as tufts 200, shown in FIGS. 5, 8, 17, 18, 21 and 22 will be formed. By such an arrangement a prescribed pattern such as illustrated in FIG. 21 may be formed in the base fabric 61, the pattern consisting of long loops 200 and short cut tufts 201.

The modified form of the present invention as illustrated in FIGS. 17-20 operates in essentially the same fashion as described above. The needles, such as needle 368, insert yarns through the base fabric to a predetermined depth below the arc of travel of both loopers 386 and 413. If the pin 398 is engaged in the slot 402 (because the finger 407 is riding in a valley 410 of drum 408), the loop pile looper 413 will be carried to the right in FIG. 20 as the needle 368 moves downwardly. The selector finger 420, of course, will also be moved with the looper 413. Thus, as the needle 368 moves downwardly, it rides along shield 423 to terminate with the eye of the needle 368 below the plane of bill 414 at the bottom dead center position of needle 368.

As the needle 368 approaches bottom dead center, the looper 413 completes its travel to the right and begins its return travel to the left so that bill 414 passes between the yarn and needle 368 to retain temporarily the yarn as the needle 368 is withdrawn from the base fabric. As the base fabric moves through the machine, it carries the loop thus formed so that the bill 414 sheds this loop and it is directed by the selector 420 around the looper 386.

On the other hand, with the pin 398 withdrawn from the slot 402, as by the finger 407 riding on raised portion 409, the loop pile looper 413 remains essentially stationary in the position shown in FIG. 17 as the cut pile looper 386 rocks to back and forth, engaging the loop of yarn carried by needle 368 as the needle 368 moves upwardly. Once engaged on looper 386, the loop is

pulled toward the closed portion or shank of the looper 386, passing over shield 423, and is cut by knife 387 as the base fabric pulls the loop to the left in FIG. 17.

It will be obvious to those skilled in the art that many variations and modifications may be made in the embodiments here chosen for the purpose of illustrating the present invention without departing from the scope thereof as defined by the appended claims.

We claim:

1. In a method of forming patterns with tufts in a base fabric wherein a yarn is successively inserted through a base fabric in a tufting zone as the base fabric is moved through said zone to form successive evenly spaced loops along the base fabric and wherein the loops when formed are carried by the base fabric from the tufting zone, the steps of engaging successive loops at various distances from the base fabric in the tufting zone to form long and short loops according to a prescribed pattern and severing the short loops in a loop cutting zone spaced from the tufting zone while guiding the long loops around the loop cutting zone thereby releasing both the short loops and the long loops without material alteration in their respective lengths.

2. In a multi-needle tufting machine for making carpets, rugs and the like wherein a series of reciprocating needles pass strands of yarn down through a base fabric to form a series of loops as the fabric is fed along a path and first looper means are positioned beneath the fabric to catch and hold the loops on the upward pass of the needles as said loops are formed and means are provided for severing the held loops on said first looper means as the loops are moved inwardly of the looper means by movement of the fabric along its path, the combination therewith of second looper means below said first looper means for catching and holding and then releasing certain of said loops and means selectively operable for precluding the catching of said certain of said loops by the first looper means and for guiding the uncaught loops around the first looper means as said uncaught loops are carried by the fabric along its path.

3. A multi-needle tufting machine of the class having a main shaft carried by the cross head member for reciprocating a transverse needle bar in a tufting zone to insert a plurality of needles carrying yarns in paths into a base fabric as the base fabric is moved longitudinally across a cross bed beneath the needles by base fabric moving means and cut pile loopers are arranged respectively in the cross bed beneath the base fabric are synchronized with the main shaft for reciprocating in paths of travel to engage and hold respectively loops of yarns formed by the needles as the needles are withdrawn from the base fabric, the bills of said cut pile loopers facing the direction of feed of the fabric and knives are arranged adjacent the cut pile loopers for severing the loops on the cut pile loopers as the loops are moved by the fabric away from the tufting zone, the combination therewith of a plurality of actuator bars movably mounted in side by side relationship on said cross bed and extending longitudinally toward said cut pile loopers, a plurality of loop pile loopers extending from said actuator bars respectively toward the path of travel of the needles, said loop pile loopers having bills arranged below and facing in an opposite direction from the bills of said cut pile loopers, a plurality of selectors operatively connected respectively to said loop pile loopers and extending respectively adjacent the paths of travel of said cut pile loopers, said selectors being selectively projectable by said actuator bars between the paths of travel of said cut pile loopers and the paths of said yarns for respectively guiding said yarns around the paths of travel of said cut pile loopers, said loop pile loopers being respectively simultaneously movable by said actuator bars and with said selectors for engaging and temporarily holding those loops formed by the yarns guided around the paths of travel of said cut pile loopers, and means for selectively actuating said actuator bars.

4. A multi-needle tufting machine of the class having a main shaft carried by the cross head member for reciprocating a transverse needle bar in a tufting zone to insert a plurality of needles carrying yarns in paths into a base fabric as the base fabric is moved longitudinally across a cross bed beneath the needles by base fabric moving means and cut pile loopers are arranged respectively in the cross bed beneath the base fabric and are synchronized with the main shaft for reciprocating in paths of travel to engage and hold respectively loops of yarns formed by the needles as the needles are withdrawn from the base fabric, the bills of said cut pile loopers facing the direction of feed of the fabric and knives are arranged adjacent the cut pile loopers for severing the loops on the cut pile loopers as the loops are moved by the fabric away from the tufting zone, the combination therewith of a plurality of actuator bars movably mounted in side by side relationship on said cross bed and extending longitudinally toward said cut pile loopers, a plurality of loop pile loopers extending from said actuator bars respectively toward the path of travel of the needles, said loop pile loopers having bills arranged below and facing in an opposite direction from the bills of said cut pile loopers, a plurality of selectors operatively connected respectively to said loop pile loopers and extending respectively adjacent the paths of travel of said cut pile loopers, said selectors being selectively projectable by said actuator bars between the paths of travel of said cut pile loopers and the paths of said yarns for respectively guiding said yarns around the paths of travel of said cut pile loopers, said loop pile loopers being respectively simultaneously movable by said actuator bars with said selectors for engaging and temporarily holding those loops formed by the yarns guided around the paths of travel of said cut pile loopers, means for reciprocating said actuator bars in synchronization with the reciprocation of said needles and means for selectively disengaging said actuator bars from said means for reciprocating said actuator bars according to a prescribed pattern.

5. A multi-needle tufting machine of the class having a main shaft carried by the cross head member for reciprocating a transverse needle bar in a tufting zone to insert a plurality of needles carrying yarns in paths into a base fabric as the base fabric is moved longitudinally across a cross bed beneath the needles by base fabric moving means and cut pile loopers are arranged respectively in the cross bed beneath the base fabric and are synchronized with the main shaft for reciprocating in paths of travel to engage and hold respectively loops of yarns formed by the needles as the needles are withdrawn from the base fabric, the bills of said cut pile loopers facing the direction of feed of the fabric and knives are arranged adjacent the cut pile loopers for severing the loops on the cut pile loopers as the loops are moved by the fabric away from the tufting zone, the combination therewith of a plurality of actuator bars movably mounted in side by side relationship on said cross bed and extending longitudinally toward said cut pile loopers, a plurality of loop pile loopers extending from said actuator bars respectively toward the path of travel of the needles, said loop pile loopers having bills arranged below and facing in an opposite direction from the bills of said cut pile loopers, a plurality of selectors operatively connected respectively to said loop pile loopers and extending respectively adjacent the paths of travel of said cut pile loopers, said selectors being respectively selectively projectable by said actuator bars between the paths of travel of said cut pile loopers and the paths of said yarns for respectively guiding said yarns around the paths of travel of said cut pile loopers, said loop pile loopers being respectively simultaneously movable by said actuator bars with said

selectors for engaging and temporarily holding those loops formed by the yarns guided around the paths of travel of said cut pile loopers, a pattern drum rotatable is synchronization with the reciprocation of said needles, sensing fingers for riding along the periphery of said drum, said drum being provided with valleys and raised portions according to a prescribed pattern, means for yieldably urging said fingers against said drum such that said fingers follow circumferentially the contour of said drum, means for reciprocating said actuator bars simultaneously in synchronization with the reciprocation of said needles, and means interconnected between said fingers and said actuator bars for selectively disengaging said actuator bars from said means for reciprocating said actuator bars in response to movement of said finger.

6. In a tufting machine of the type having reciprocating needles for inserting yarn through a base fabric to form loops and wherein first loopers are provided below the needles and oscillated in predetermined paths for catching, holding and severing said loops, the combination therewith of second loopers, means for operatively associating said second loopers with said first loopers and said needles, and means for oscillating said second loopers in other predetermined paths when actuated for catching and temporarily holding said loops to the exclusion of said first loopers, means operative in conjunction with said second loopers for guiding said loops caught by said second loopers around said first loopers, and means for selectively actuating and deactuating said second loopers.

7. In a method of producing pile tufts in a base fabric wherein a plurality of yarns are successively inserted in a transverse line through said base fabric as said base fabric is progressively moved through a tufting zone to form successive transverse rows of loops and wherein the loops of yarn in one row are normally caught and held in said tufting zone and are thereafter moved by the movement of said base fabric, as subsequent row or rows of loops are formed, away from said tufting zone to positions where the loops are severed to form cut pile tufts of a predetermined first loop length, the step of selectively catching according to a prescribed pattern and at a predetermined second loop length greater than said first loop length certain of said loops which otherwise would have been caught and subsequently cut as aforesaid, temporarily holding said certain of said loops, releasing said certain of said loops prior to the formation of a subsequent row of loops and moving said certain of said loops past the positions where the same would otherwise have been cut while preventing the severing of said certain of said certain of said loops as they are so moved.

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